

NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE
NAME

SUBJECT
CLASS

REGISTRATION
NUMBER

CHEMISTRY

Paper 1 Multiple Choice

9729/01

Thursday 19 September 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

A Data Booklet is provided.

Instructions on how to fill in the Optical Mark Sheet

Shade the index number in a 5 digit format on the optical mark sheet:

2nd digit and the last 4 digits of the Registration Number.

Example:

Student	Examples of Registration No.	Shade:
	1805648	85648

- 1 When a sports medal with a total surface area of 150 cm^2 was evenly coated with silver by electrolysis, its mass increased by 0.216 g .

How many atoms of silver were deposited per cm^2 on the surface of the medal?

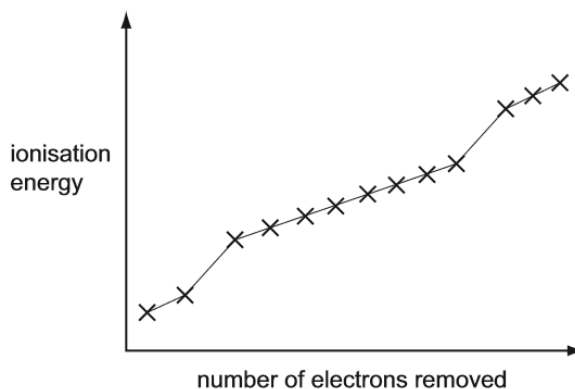
- A 8.0×10^{18} B 1.8×10^{19} C 1.2×10^{21} D 4.1×10^{22}
- 2 Which species is deflected to the greatest extent in an electric field?
- A e^- B H^+ C He^{2+} D F^-
- 3 In an experiment, 50.0 cm^3 of a 0.10 mol dm^{-3} solution of M^{3+} salt reacted exactly with 25.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium sulfite.

The half-equation for oxidation of sulfite ion is shown below.



What is the final oxidation number of **M**?

- A +1 B +2 C +4 D +5
- 4 The graph shows the first thirteen successive ionisation energies for element **E**.



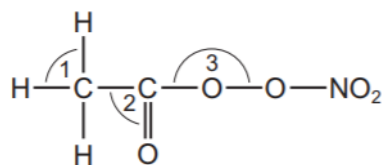
What can be deduced about element **E** from the graph?

- A It is in Period 3 of the Periodic Table.
- B It is a d-block element.
- C It is in Group 2 of the Periodic Table.
- D It is aluminium.

- 5 What is the order of increasing radii for the three species shown?

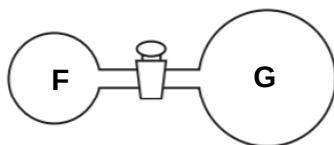
	smallest $\longrightarrow$ largest		
A	Ar	Ca ²⁺	K ⁺
B	Ar	K ⁺	Ca ²⁺
C	Ca ²⁺	K ⁺	Ar
D	K ⁺	Ar	Ca ²⁺

- 6 Organic nitrates in photochemical smog can cause breathing difficulties. The diagram shows an example of an organic nitrate molecule.



What is the order of increasing bond angles?

- A** $1 < 2 < 3$ **B** $2 < 1 < 3$ **C** $3 < 1 < 2$ **D** $3 < 2 < 1$
- 7 Two glass vessels **F** and **G** are connected by a closed valve.



F contains helium at 20 °C at a pressure of 1×10^5 Pa. **G** has been evacuated, and has three times the volume of **F**. In an experiment, the valve is opened and the temperature of the whole apparatus is raised to 100 °C.

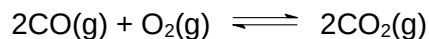
What is the final pressure in the system?

- A** 3.18×10^4 Pa **B** 4.24×10^4 Pa **C** 1.25×10^5 Pa **D** 5.09×10^5 Pa

- 8 Carbon monoxide burns readily in oxygen to form carbon dioxide.

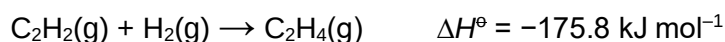
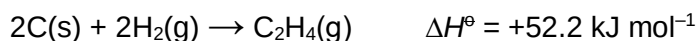
What can be deduced from this information?

- 1 The +4 oxidation state of carbon is more stable than the +2 state.
- 2 The standard enthalpy change of formation of carbon dioxide is less negative than that of carbon monoxide.
- 3 The value of the equilibrium constant for the following reaction is likely to be high.

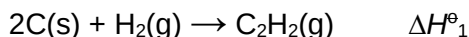


- A** 1, 2 and 3 **B** 2 and 3 **C** 1 and 3 **D** 1 only

- 9 Two reactions and their enthalpy changes are shown.



These data can be used to calculate the enthalpy change for the reaction shown.



What is the value of $\Delta H^\ominus_1$?

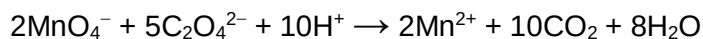
- A** $-228.0 \text{ kJ mol}^{-1}$ **B** $-123.6 \text{ kJ mol}^{-1}$ **C** $+123.6 \text{ kJ mol}^{-1}$ **D** $+228.0 \text{ kJ mol}^{-1}$

- 10 Butanedioate ions can be dehydrogenated to form trans-butenedioate ions. The enzyme fumarase speeds up this reaction.

How does fumarase speed up this reaction?

- A** Fumarase increases the kinetic energy of the reactants.
- B** Fumarase increases the frequency of collisions between reactants.
- C** Fumarase lowers the activation energy of the dehydrogenation reaction.
- D** Fumarase is specific for this dehydrogenation reaction.

- 11** The reaction between ethanedioate ions and acidified manganate(VII) ions as shown below takes place very slowly in the cold but can be accelerated with heat or with addition of Mn^{2+} catalyst.



The reaction rate for the reaction can be measured by noting the time elapsed for the purple colour of the manganate(VII) ions to disappear.

The following results were obtained.

Expt	Volume / cm^3				Time / s
	$\text{C}_2\text{O}_4^{2-}(\text{aq})$	$\text{MnO}_4^-(\text{aq})$	$\text{Mn}^{2+}(\text{aq})$	water	
1	20	30	5	25	30
2	20	30	10	20	15
3	20	15	10	35	15
4	20	20	20	20	10

Which conclusions can be drawn about the reaction?

- 1 The reaction is first order with respect to $\text{Mn}^{2+}(\text{aq})$.
- 2 MnO_4^- is involved in the rate-determining step.
- 3 The unit of rate constant is $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$.

A 1 only **B** 1 and 2 **C** 2 and 3 only **D** 1, 2 and 3

- 12** In which reactions does NH_3 behaves as a Lewis base?

- 1 $2\text{NH}_3 \rightarrow \text{NH}_2^- + \text{NH}_4^+$
- 2 $\text{HSO}_4^- + \text{NH}_3 \rightarrow \text{SO}_4^{2-} + \text{NH}_4^+$
- 3 $\text{Ag}^+ + 2\text{NH}_3 \rightarrow [\text{Ag}(\text{NH}_3)_2]^+$

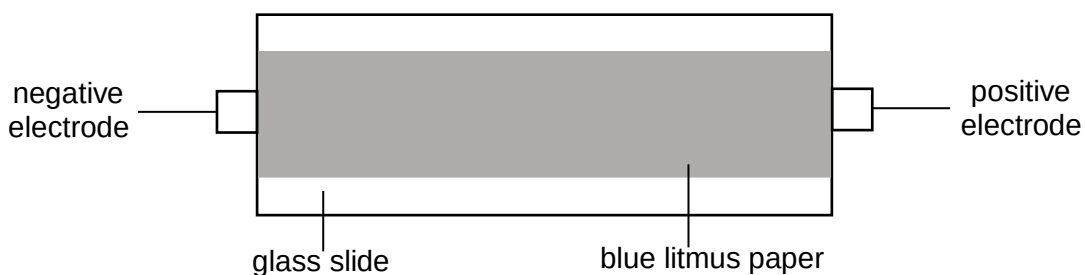
A 1 only **B** 1 and 2 **C** 2 and 3 **D** 1, 2 and 3

- 13** The numerical values of the solubility products of three metal sulfides are tabulated below.

compound	numerical value of solubility product
CuS	8.5×10^{-45}
Ag ₂ S	1.6×10^{-49}
Bi ₂ S ₃	1.1×10^{-73}

What is the order of increasing molar solubility of the three metal sulfides in water?

- A** Bi₂S₃ < Ag₂S < CuS
- B** CuS < Ag₂S < Bi₂S₃
- C** Ag₂S < Bi₂S₃ < CuS
- D** CuS < Bi₂S₃ < Ag₂S
- 14** A piece of blue litmus paper was soaked in concentrated NaCl solution and supported on a glass slides. The paper was connected to a direct current supply as shown in the diagram below.



What are the observations near the negative electrode and the positive electrode after the current had flown for some time?

	negative electrode	positive electrode
A	blue	red
B	red	blue
C	blue	bleached
D	bleached	blue

15 Which statement does **not** describe the chemical properties of Period 3 compounds?

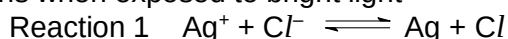
- A SiO_2 is formed from the hydrolysis of SiCl_4 .
- B Al_2O_3 is soluble in both acid and base.
- C Equimolar of Na_2O and SO_3 can be mixed in water to give a pH neutral solution.
- D The acidity of Period 3 chlorides in water decreases from NaCl to PCl_5 .

16 A 5.00 g sample of an anhydrous Group 2 metal nitrate loses 3.29 g in mass when heated strongly. What is the identity of the metal?

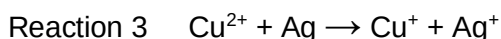
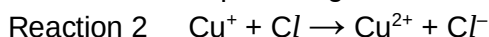
- A magnesium B calcium C strontium D barium

17 Transition lenses are made of photochromic glass.

Photochromic glass darkens when exposed to bright light



Photochromic glass becomes more transparent again when the light is less bright.



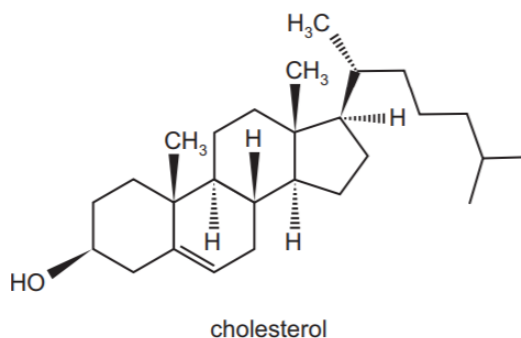
Which statement about these reactions is correct?

- A Ag^+ ion are oxidised.
- B Cu^+ ion act as catalyst.
- C Cu^+ ion act as an oxidising agent.
- D The depth of colour of the photochromic glass is related to the concentration of Cl .

18 Which environmental problem is **not** made worse by the release of oxides of nitrogen from car engines?

- A acidification of lakes
- B corrosion of buildings
- C photochemical smog
- D soil pollution

- 19 The diagram shows the structure of the naturally-occurring molecule cholesterol.



Which statements about cholesterol are correct?

- 1 The molecule contains a secondary alcohol group.
- 2 The molecule have two π bonds.
- 3 All carbon atoms in the four rings lie in the same plane.

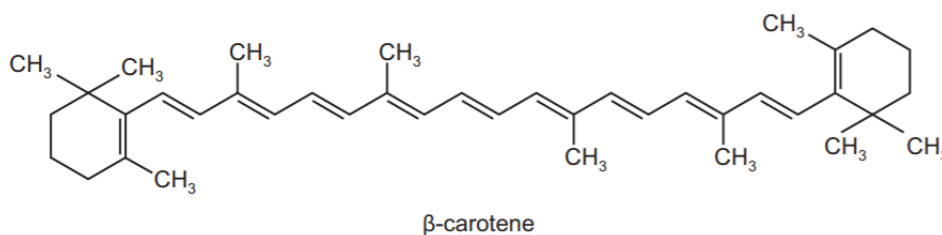
A 1, 2 and 3 **B** 1 and 2 **C** 1 and 3 **D** 1 only

- 20 The presence of 11-cis retinal, $C_{20}H_{28}O$, in cells in the eye is important for vision. The structure of retinal includes an aldehyde group, a cyclohexene ring and a long aliphatic side chain, in which a carbon-carbon double bond exists between carbons numbered 11 and 12.

Which pair of statements about 11-cis retinal could be correct?

	total number of C=C double bonds	arrangement around adjacent carbons C11 and C12
A	5	
B	5	
C	6	
D	6	

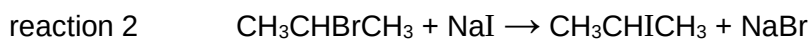
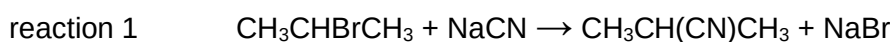
- 21 β -carotene is responsible for the orange colour of carrots.



β -carotene is oxidised by hot, concentrated, acidified KMnO_4 . When an individual molecule of β -carotene is oxidised in this way, many product molecules are formed.

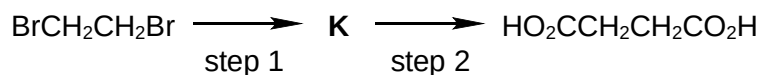
How many of these product molecules contain ketone functional group?

- A 4 B 6 C 8 D 11
- 22 Under identical conditions, even though it proceeds by the same mechanism, reaction 1 is faster than reaction 2.



What factor will explain this result?

- A The C-I bond is a stronger bond than the C-Br bond.
- B The C-N bond is a stronger bond than the C-I bond.
- C The cyanide ion is a stronger nucleophile than the iodide ion.
- D The cyanide ion is a weaker nucleophile than the iodide ion.
- 23 Butanedioic acid occurs in amber, algae, lichens, sugar cane and beets. It may be synthesised in two steps from 1,2-dibromoethane.



Which reagents could be used for this synthesis?

	step 1	step 2
A	HCN(g)	HCl(aq)
B	$\text{HCO}_2\text{Na(aq)}$	HCl(aq)
C	ethanolic KCN	$\text{H}_2\text{SO}_4\text{(aq)}$
D	NaOH(aq)	acidified $\text{K}_2\text{Cr}_2\text{O}_7$

- 24 Many, but not all, organic reactions need to be heated before reaction occurs.

Which reaction occurs at a good rate at room temperature (20 °C)?

- A $\text{CH}_3\text{OH} + \text{PCl}_5 \rightarrow \text{CH}_3\text{Cl} + \text{POCl}_3 + \text{HCl}$
- B $\text{CH}_3\text{CH}_2\text{Br} + \text{KCN} \rightarrow \text{CH}_3\text{CH}_2\text{CN} + \text{KBr}$
- C $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{C}_2\text{H}_4 + \text{H}_2\text{O}$
- D $\text{CH}_3\text{CH}_2\text{CN} + 2\text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{CO}_2\text{H} + \text{NH}_3$

- 25 2.76 g of ethanol were mixed with an excess of aqueous acidified potassium manganate(VII). The reaction mixture was then boiled under reflux for one hour. The organic product was then collected by distillation. The yield of product was 75.0%.

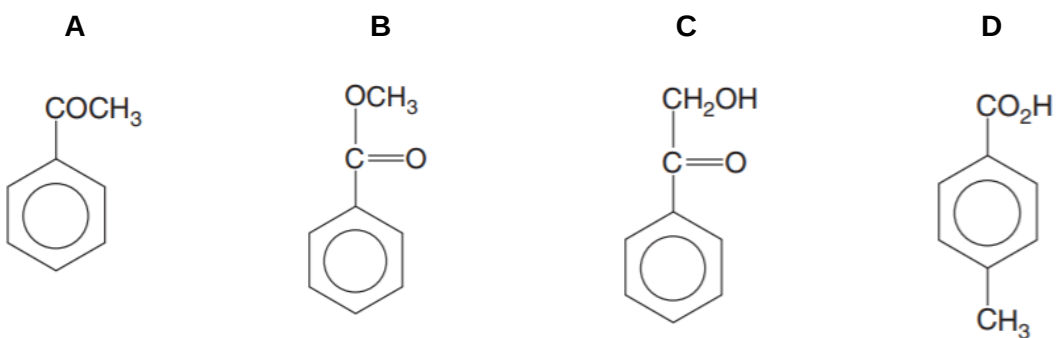
What mass of product was collected?

- A 1.98 g B 2.07 g C 2.70 g D 4.80 g

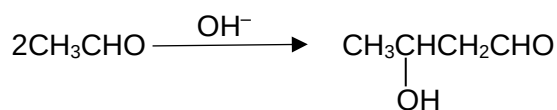
- 26 A compound **N** has all of the following properties:

- it is neutral;
- it gives an orange precipitate with 2,4-dinitrophenylhydrazine;
- it evolves white fumes of HCl when treated with PCl_5 in the cold.

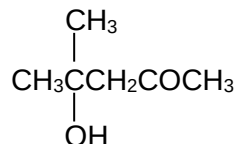
Which molecule is compound **N**?



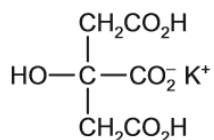
- 27 In the presence of dilute alkali, some aldehydes and ketones undergo the 'aldol reaction' where they dimerise to form a hydroxycarbonyl compound (an aldol). For example, ethanal reacts as shown to form 3-hydroxybutanal.



Which carbonyl compound will undergo the aldol reaction to produce the aldol shown below?



- A CH_3COCH_3
 B $\text{CH}_3\text{CH}_2\text{CHO}$
 C $(\text{CH}_3)_2\text{CHCHO}$
 D $\text{CH}_3\text{CH}_2\text{COCH}_3$
- 28 Monopotassium citrate is used as an emulsifying agent in powdered milk. It may be represented by the formula shown.

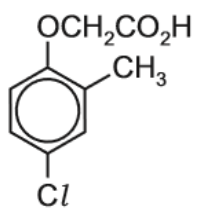


Which statements about monopotassium citrate are correct?

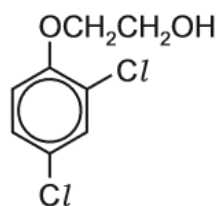
- 1 It can exist as a pair of enantiomers.
- 2 It can act as a dibasic acid.
- 3 It can form esters with both carboxylic acids and alcohols.

- A 1, 2 and 3 B 1 and 2 C 2 and 3 D 1 only

- 29 L and M are two widely-used selective weed killers.



L



M

Which reagent will distinguish L from M?

- A acidified $\text{AgNO}_3(\text{aq})$
 B acidified $\text{KMnO}_4(\text{aq})$
 C $\text{Na}(\text{s})$
 D $\text{Na}_2\text{CO}_3(\text{aq})$
- 30 Which pair of compounds is formed when the ester $\text{CH}_3\text{OCOC}_2\text{H}_5$ is boiled with aqueous sodium hydroxide?
- A CH_3OH + $\text{C}_2\text{H}_5\text{CO}_2\text{H}$
 B CH_3ONa + $\text{C}_2\text{H}_5\text{CO}_2\text{Na}$
 C CH_3OH + $\text{C}_2\text{H}_5\text{CO}_2\text{Na}$
 D $\text{CH}_3\text{CO}_2\text{Na}$ + $\text{C}_2\text{H}_5\text{OH}$